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ENALLAGMA OPTIMOLOCUS, A NEW SPECIES OF DAMSELFLY FROM MONTANA (ODONATA: COENAGRIONIDAE)

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Abstract.—***Enallagma optimolocus*** n. sp. is described and diagnosed from streams in western Montana. Garrison's 1984 key is modified to distinguish this species from the related *E. carunculatum* Morse and *E. civile* (Hagen). The competing aspects of two views of these specimens, i.e. full species or hybrid individuals, is discussed. The occurrence of *E. carunculatum* and *E. anna* Williamson at the collecting sites is noted. The absence of *E. civile* from the areas surrounding the range of *E. optimolocus* is noted, with Roemhild's 1975 (and Garrison's 1984) record of *E. civile* for Flathead Co., Montana, corrected to *E. carunclulatum*. Illustrations of diagnostic features for the species are given.

Key Words: damselfly, Montana, taxonomy

The Odonata are perhaps the taxonomically best known Order of North American insects, with virtually all species described, and the vast majority of both sexes and nymphs known (Kosztarab and Schaefer 1990, McCafferty et al. 1990). Indeed, in an analysis of the taxonomic status of the Odonata of North America north of Mexico, McCafferty et al. (1990) suggested that most of what remained to be discovered would be species range extensions along the southern boundaries of the region. The rate of description of new species from North America has slowed to an average of less than one per year, and at that rate, known collected-but-undescribed North American species may run out before the decade is over.

This condition seems directly tied to the fact that the Odonata are second only to the butterflies and a few families of beetles in number of enthusiasts. Checklists and faunistic papers exist for most States and Provinces of the United States and Canada, including Roemhild's (1975) list for Montana damselflies. Still, there are poorly sampled regions, especially in the central parts of the continent, where much remains to be done to document the fauna. Of the last three dragonflies described from North America (Carle 1992, Dunkle 1992, Vogt and Smith 1993) one came from the north central States, one from the Gulf Coast of Louisiana, and only one from the Texas–Mexico border area.

Montana, with a huge and diverse area of relatively intact ecosystems and a very sparse human population (including entomologists and insect collectors), represents one of the most poorly known parts of the continent. Never-the-less, it was a surprise to discover an undescribed species of *Enallagma* while conducting a survey of the Odonata of Montana.

Many Odonata are quite sensitive to water quality, and are susceptible to many pollutants (Carle 1979). McCafferty et al. (1990) list 30 North American species (of a total 415) as extinct, endangered, vulnerable, or rare. The presence of this new, rare, and possibly localized species in several of the world's most famous fishing waters bes-

peaks both a healthy environment and a continuing need to protect those waters and their sources.

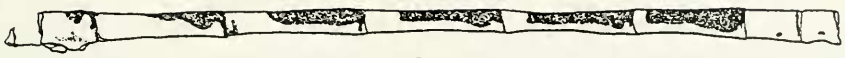
The genus *Enallagma* contains approximately 75 species world-wide (Garrison 1984), 36 of those in the United States and Canada (McCafferty 1990, plus a new record of a Mexican species in southern Arizona, Garrison in lit.). Garrison (1984) provided the most recent revision of the species of western North America. The eastern species are covered in regional faunistic treatments by a combination of Walker (1953), Johnson (1972) and Dunkle (1990). The description below follows the format of Garrison (1984).

Enallagma optimolocus, New Species

Holotype ♂: MONTANA: Flathead County, Whitefish River 4.5 km SW Whitefish, sw ¼, sw ¼ sec. 9, T. 30 N., R. 21 W., 27 July 1993, Kelly B. Miller leg. [Montana Entomology Collection, Bozeman (MTEC), on permanent loan to the California Academy of Sciences, San Francisco]. Paratypes (16 ♂♂): 8—*ibid.*; 2—*ibid.*, 07 August 1993; 2—*ibid.*, 08 August 1991; 1—*ibid.*, 24 June 1992; 1—MONTANA: Madison County, Madison River, confluence with Cherry Creek, sec. 36, T. 2 S., R. 2 E., 14 July, 1992, Kelly B. Miller leg; 1—MONTANA: Lewis and Clark Co., Beaver Creek, by river, 8/25/1993, D.W. Lundahl colr. [deposited in the MTEC (12) and the collections of K. B. Miller (2), T. Donnelly (1) and R. Garrison (1)]. All specimens were acetone-treated, and prepared in Mylar® envelopes.

Etymology.—From the Latin optimum (best) and locus (place). A shortened form of the unofficial motto of Montana, "The Last Best Place."

MALE. Head—Dorsum black with blue, subtriangular postocular spots between eyes and posterior margin of occiput; hind margin of occiput with mesal thin, blue line; rear of head light blue; face, genae blue; postclypeus black; anteclypeus, labrum and labium blue; antennae black. Thorax—Pronotum black dorsally with lateral spots and hind margin blue; prothoracic pleura and sternum blue. Pterothorax blue with longitudinal stripes black; mesostigmal plates black mesally, light blue laterally; mid-dorsal carina and antealar crests black; mid-dorsal stripe 1.8× the width of blue antehumeral stripe; average width of humeral stripe about 0.3× the width of mid-dorsal stripe, slightly wider at base (near legs) than at apex (near wings) [one paratype (from Madison Co.) with stripe constricted to a thin line medially]; black spot at upper end of second lateral suture; remainder of thorax blue. Legs—Femur black externally, pale internally; tibia pale posteriorly, black anteriorly; tarsi pale with black apically on each tarsomere or, occasionally entirely dark; claws pale with black at tips; spines black. Wings hyaline, stigma black. Abdomen (Fig. 1).—Segment I blue, occasionally with a small, lateral black spot apically; segment II blue with dorsal black transverse spot in posterior half of segment connected to black posterior annulus; segment III blue with apical 0.50 to 0.70 black dorsally; segment IV blue with apical 0.50 to 0.75 black dorsally; segment V blue with apical 0.50 to 0.75 black dorsally; segment VI blue with apical 0.75 to 0.80 black dorsally; segment VII black dorsally with thin margin of blue proximally; segment VIII and IX entirely blue, except for occasionally a small line of black apically, and sometimes a small, elongate black spot laterally on one or both segments; segment X black dorsally. All segments blue laterally. Terminalia (Figs. 2, 3, 4, 5).—Superior appendages black; inferior appendage pale except dorsally and apically black. In lateral view, superior appendage slightly longer than inferior appendage; pale tubercle visible between upper and lower arms of superior appendage; margin of juncture of arms of superior appendage at about right angle; in dorsal view, pale tubercle visible on interior of superior appendage as longitudinal mass, not visible beyond su-



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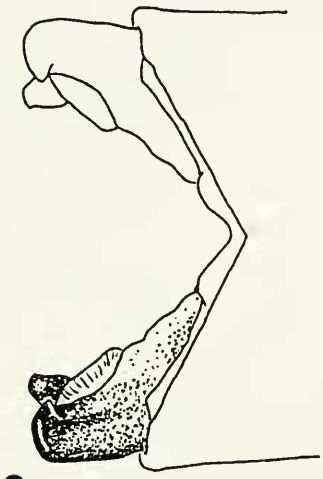

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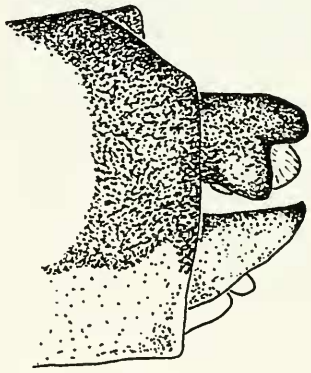

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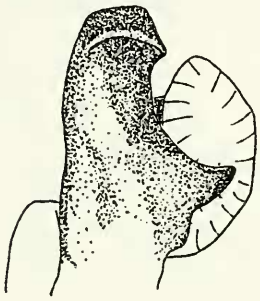

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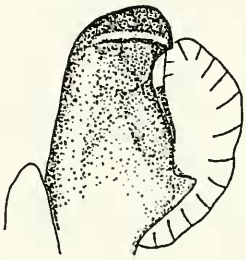

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Figs. 1–5. *Enallagma optimolocus*. 1, Lateral view of abdomen. 2, Male abdominal terminalia, dorsal view, 3, left lateral view. 4–5, Right superior appendage of male genitalia, showing extremes of development of mesally pointed black tooth, lateral oblique view.

perior appendage; mesally pointed, black tooth on lower arm of superior appendage variable, present and prominent in one-third of the types, absent in one-third of the types and intermediate in one-third of the types; inferior appendages evenly curved when viewed laterally.

Length.—30.5–33.2 mm, abdomen, 23.9–27.0 mm, hind wing, 19.0–19.1 mm, hind femur 2.9–3.0 mm.

Female and nymph.—unknown.

Diagnosis

The form of the male genitalia will distinguish this species from its congeners. Females are not known. The color pattern of the abdomen (Fig. 1) of *E. optimolocus* males is similar to that of *E. carunculatum* Morse, but *E. optimolocus* differs from that

species in having the superior appendage extending beyond the pale tubercle (Figs. 2, 3, 4, 5). The terminalia of *E. optimolocus* (Figs. 2, 3, 4, 5) are similar to those of *E. civile* (Hagen), but differ in the form of the superior appendage in lateral view (Fig. 3). The black tooth on the inner margin of the superior appendage is small, and usually surrounded by the pale tubercle (Figs. 4, 5). Lastly, in *E. optimolocus* the abdomen has tergites III, IV, and V with 50% or more black along the dorsum. Geographically, *E. optimolocus* is sympatric and flies together with *E. carunculatum* throughout its known range. *Enallagma civile* is rarely taken in Montana, to date only to the east of *E. optimolocus* localities, with the closest record 45 km distant (K. Miller, unpubl.). Roemhild's (1975) record of *E. civile* from Flathead Co., Montana (repeated on Garrison's (1984) distribution map), is a misidentification of a specimen of *E. carunculatum* [MTEC].

In Garrison's (1984) key *E. optimolocus* keys to couplet 7 where it fits neither choice. The following emendation of couplet 7 is required to accommodate *E. optimolocus* in Garrison's key:

7. In dorsal view, pale tubercle visible well beyond the upper arm of superior appendage (Fig. 63b from Garrison 1984) . . . . . *E. carunculatum* Morse

7′. In dorsal view, pale tubercle not visible beyond the upper arm of superior appendage (Figs. 2, 3, 4) 7a

7a. Height of upper arm of superior appendage ⅓ to ¼ total height of superior appendage; dorsal surface of abdominal segments III, IV, and V black in posterior one-quarter; lower arm of superior appendage with a large mesally pointed black tooth (Fig. 64b from Garrison 1984). . . . . *E. civile* (Hagen)

7a′. Height of upper arm of superior appendage approximately ½ total height of superior appendage; dorsal surface of abdominal segments III, IV, and V black in posterior one-half or more; lower arm of superior appendage moderate to obsolete mesally pointed black tooth . . . . . *E. optimolocus* n. sp.

Discussion

The discovery of these specimens has lead to a lively and very productive discussion among colleagues about the status of these individuals. The debate centers on 2 competing hypotheses: that the specimens represent an undescribed species, and that because they exhibit characteristics somewhat intermediate between *E. carunculatum* and *E. anna* Williamson, both of which occur at all known localities of *E. optimolocus*, they represent a series of hybrids. Another suspected parent, based upon morphology, is *E. civile*, but it is unknown in the areas where *E. optimolocus* has been found (see above). We have come down on the side of those who support the full species status, and provide the following explanation for that viewpoint.

First, if non-overlapping characteristics intermediate between other species was grounds for hybrid status, several other species of *Enallagma* would have to be so considered. Hybridization in damselflies is rare, but has been observed (Williamson 1906, Leong et al. 1992, Garrison pers. com., Donnelly pers. com.). All known cases fit the normal hybridization situation, i.e. either occurring commonly in a narrow hybrid zone between 2 basically allopatric species, or very rarely in situations where sympatric species occur with one parent species very common, and the other extremely rare. This makes good biological sense, since hybridization would be selected against in widely sympatric species, increasing the development of barriers to its occurrence.

Neither of these expected situations fits this case. The locally available candidates for parents, *Enallagma carunculatum* and *E. anna*, are sympatric over most of the western USA (Garrison 1984), including all areas where *E. optimolocus* have been taken. Thousands of specimens of these 2 species have been collected within this area of sympatry, and even if hybrids were very rare, they should have turned up throughout the range. At the Whitefish River site, some ⅓ of male *Enallagma* specimens taken in 1993 were *E. optimolocus*. Of the remaining ⅔, the vast majority were evenly divid-

ed between *E. carunculatum* and *E. anna*. Only 3 damselflies were taken the day the Beaver Creek specimen was collected (D. Lundahl, pers. com.), and only a small number of specimens were taken the day the Madison River specimen was found. Because only the 1993 specimens were recognized in the field, the others represent a relatively random sample mixed in with small samples of common species. Lack of females is explained by the fact that for conservation reasons only male *Enallagma* are taken during normal collecting, as females are basically non-useful for documenting a species' occurrence, and are therefore left to breed. The species has not been seen since the need for females for a type series was recognized.

Another problem with resolving the hybridization hypothesis is the lack of phylogenetic information. Based on arrangement of species in Garrison (1984), it would appear that the 2 possible parents are not closely related within the genus. If this is supported by a cladistic analysis, hybridization would not be expected to occur between such distantly related species.

Lastly, from a conservation biology standpoint, it may be wisest to treat *E. optimolocus* as a full species until the null hypothesis can be tested.

However, the lack of females leaves the situation open to question, although female *Enallagma* are notoriously hard to distinguish (Garrison 1984). Careful biological and genetic investigations are needed as a follow up test of the hypothesis that *E. optimolocus* is indeed a good species.

Biological Notes

The type locality is a slow, clear stream in a very broad, glacial valley in the Rocky Mountain Trench. The Whitefish River at that point has a silt bottom, with an abundant insect fauna, with at least twelve other Odonata species occurring at this site. Most common were *E. carunculatum, E. anna, Calopteryx aequibilis* (Say), *Aeshna umbrosa* Walker, *Ophiogomphus severus* Hagen, and *Argia emma* Kennedy. The Madison River locality is at the confluence of a small stream with a broad river in an intermountain valley. The river is a freestone stream below a shallow reservoir, whereas Cherry Creek is silt-bottomed and clear. This area also possesses a very abundant insect fauna for a Montana freestone mountain stream, with six other Odonata known to occur in the immediate area. Most common were *E. carunculatum, E. anna, Ophiogomphus severus* Hagen, and *Argia emma* Kennedy.

In general, the behavior of this species was observed to be similar to that of *E. carunculatum* at the type locality, flying together with that species through the grasses and sedges emergent at the waters' edge. *Enallagma anna* was also present, but tended to fly over more open water and rest on emergent water buttercup (*Ranunculus aquatilis*). Males flew very low over the stream often landing on grasses or emergent stream vegetation very near the water. They were wary and difficult to capture.

Acknowledgments

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